Single atom chemical identification of TMD defects in ambient conditions

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OPEN ACCESS ARTICLE

Hello {{lead.First Name:default=researcher}},

For this month's AFM Materials Journal Club, I would like to share with you a paper titled, "Single atom chemical identification of TMD defects in ambient conditions."

Observation of atomic point defects with AFM remains challenging, particularly under ambient conditions. In this paper, researchers from Lancaster University and University of Sheffield demonstrate that conductive atomic force microscopy (C-AFM) can achieve single-atom resolution imaging of defects in 2D materials while providing the sensitivity to the local electronic structure needed to infer defect identity.

The authors use a Bruker MultiMode AFM to investigate mechanically exfoliated MoS_2, WSe_2, and WS_2 monolayers on conductive HOPG substrates under ambient conditions. The atomic resolution C-AFM reveals two dominant defect classes:

1. point defects localized to single atomic sites, and
2. less common diffuse defects extending several nanometers and affecting multiple lattice sites.

Defects were observed and densities quantified in all three materials, but characterization was challenging in WS_2 due to strong moiré patterns arising from the underlying HOPG substrate.

The chemical sensitivity of the method was then investigated by intentionally doping WSe_2 using nitrogen plasma. C-AFM distinguishes oxygen substitutions (OSe) from nitrogen substitutions (NSe) based on subtle differences in current contrast between defect sites.

Finally, this work provides insight into the mechanism of ambient atomic resolution C-AFM, attributing it to stable nanoscale asperities at the diamond coated probe apex rather than insulating tunneling barriers.

I hope you find this article interesting. For questions, please feel free to **reach out to me** or anyone in our **AFM applications team**.

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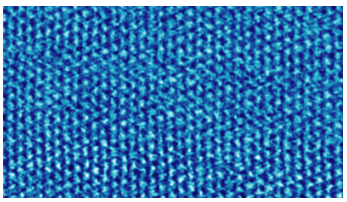

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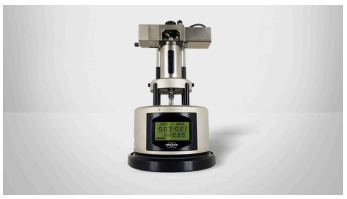

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